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Experimental Validation of Pore-Scale Models for Gas Diffusion Layers in PEMFCs

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Pore-scale modeling developed over the past decades has become a powerful method to evaluate the effective transport properties of porous electrodes. Experimental verification for such a method is crucial to confirm the method's validity. In this study, experimental data of gas diffusion layer (GDL) are compared with results of pore-scale modeling. GDL microstructures are scanned and reconstructed by X-ray computed tomography. Explicit dynamic simulations based on the finite element method are performed on these reconstructed models to reveal the 3D displacement of the microstructure during compression. Over the deformed models, the effective diffusivity, thermal and electrical conductivities are then computed using a pore-scale model code. It is found that, as the compression ratio increases to 30%, the fiber displacement increases obviously with significant anisotropy, and the fibers gradually squeeze into nearby pores located in the adjacent layers inside GDL. The effective diffusivity and permeability decrease by about 15% and 35% respectively. The conductivity increases by 100% and 20% in the through-plane and in-plane direction respectively. The validated methods can support microstructure optimization and transport properties improvement for different types of porous electrodes.

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References

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